U.S. looks to unmanned blimps to improve missile defense

BY J.R. WILSON

Under management of the Missile Defense Agency, the U.S. government is resurrecting the blimp, which last saw service with the Navy in 1962. Experts will test the High Altitude Airship (HAA) as an unmanned platform for a wide range of sensors for communications, weather/environmental monitoring, short- and long-range missile warning, surveillance, and target acquisition.

The $40 million advanced-concept technology-demonstration (ACTD) program is part of MDA's effort to develop innovative concepts to detect a missile attack against the United States or its allies during the boost, midcourse, and terminal phases of missile flight. Also supporting the HAA are the U.S. Army, the U.S. Northern Command (NORTHCOM), and the U.S. Department of Homeland Security (DHS).

"NORTHCOM's interest is mostly as a sensor platform, which coincides with ours," says Gary Payton, MDA's deputy director for Advanced Systems. "The Army likes it because it is a great communications relay platform and surveillance asset, capable of carrying a synthetic aperture radar, for example."

Despite its potential value to several agencies and missions, he adds, only MDA's director, Lt. Gen. Ronald Kadish, was willing to take the lead and push the program forward, in much the same way early unmanned aerial vehicles (UAVs) had to find a benefactor to support their development in the early 1990s.

"Our interest as an MDA platform is predominantly for sensors that could be located close to where the bad guys launch from IR/EO (infrared/electro-optical) sensors that detect early launch and pass it on to the rest of MDA's assets," Payton says. "Or you could put it off the U.S. coast and look up, with the right sensors giving it midcourse ability to watch things coming toward us. So it has multiple potential uses for missile defense."

Lockheed Martin Maritime Systems & Sensors (MS2) in Akron, Ohio, has carried HAA through the first two phases, with a critical design review and risk reduction, second phase, scheduled as this magazine went to press. The CDR leads to a phase-three production and test award, which Lockheed Martin officials anticipate will allow them to begin flight tests by summer 2006.

Full-scale prototype

Engineers will build the test-flight prototype to full-scale dimensions — 500 feet in length and 150 feet in diameter — making the HAA one of the largest airships ever built. The German dirigible Hindenburg, by contrast, was 804 feet long and 135 feet in diameter. A catastrophic fire destroyed that airship in 1936 at an airfield in Lakehurst, N.J.

Unlike the earlier behemoths, HAA will be nonrigid, unmanned, and relatively fast — with 70 to 75 knots transit speed at altitudes of 60,000 to 75,000 feet — just shy of the ill-fated Hindenburg's record top speed. Perhaps most important, it will also be able to maintain station within about a mile of its target position at least 50 percent of the time and within about 60 miles 95 percent of the time. At its operating altitude, HAA will have a visual line of sight of about 400 miles to the horizon.

"We have several modes of flight control. One is autonomous, where you load a computer program into the avionics, and it flies to certain waypoints and maintains altitude. It can be programmed to keep one side of the gondola pointed in a specific direction and use GPS (global-positioning system) navigation to stay within a certain box on station," Payton says. "Then we have an RPV (remotely piloted vehicle) mode where commands are sent up to fly to a new waypoint."

All of the test-vehicle avionics are commercial off-the-shelf (COTS) and redundant. Some come from the space-shuttle program, such as SIGI (Space Integrated GPS/INS), and others from the F-22 fighter (Boeing 777 commercial airliner) and assorted unmanned-aerial-vehicle (UAV) programs (which also are the source for the flight-control system's fundamental algorithms). In addition to a variety of direct and line-of-sight (LOS) communications from the ground, HAA also will use an Iridium communications satellite connection for over-the-horizon communications.

"All the electricity comes from solar arrays on top of the vehicle," Payton says. "This array is about the size of a hockey rink some 90 feet long by 40 to 50 feet wide. It is a collection of amorphous silicon panels bonded to the fabric of the airship. Amorphous silicon has an efficiency in the 6- to 9-percent range — not as efficient as what we fly on satellites but it's cheaper, easier to build, and flexible, so it can bend as the fabric bends."

Lockheed Martin, which bought the old Goodyear blimp factory in Akron that produced a world record 300-plus airships during the 20th century, says HAA will be able to keep as much as two tons of multiple-mission payloads on station for at least a month at a time.

Propelling the airship are four brushless motors made by noted UAV designer AeroVironment in Monrovia, Calif., which helped NASA with a high-altitude solar plane in 2001. Lithium-ion batteries will power HAA

contunied on pg. 6

BLIMPS contunied from pg. 4

at night, recharged by the solar array during the day. A new fuel-cell technology that NASA is developing may be incorporated to supplement the thin-film photovoltaic cells in producing multiple kilowatts of power 24 hours a day for HAA's four 30-foot vectored propellers. In addition, 10 kilowatts will be dedicated to powering its assorted sensor payloads.

Payton says if HAA can maintain station for 30 days, there is no limit to how long it could stay up, but there could be limits on where it stays up.

"Being solar-powered and depending on the design of the vehicle at certain latitudes, the sun angle is so low you wouldn't have enough power coming out of the solar array to perform the mission," he explains. "So latitude rather than range is the restraint for an operational derivative of this technology.

"One of the disadvantages is this airship doesn't go anywhere very fast, which is where aircraft such as Global Hawk have the advantage. So if you wanted to keep them all in the continental U.S., it would take a while to get them deployed very far away."

Remote storage for grounded airships is also a concern. MDA says an inflatable structure could do the job for short periods, but long-term storage would require a huge permanent structure. This describes HAA's assembly site, the historic Goodyear Airdock, an 1175-foot-long airship factory used to build the Navy's fleet. The facility's 211-foot height and 325-foot width will accommodate the HAA, as well as the equipment and people who build it.

"We couldn't do this without the avionics and electronics improvements of the last 12 years in the realm of redundant flight control and UAV technologies," Payton says. "The fact that we can fly beyond LOS with commercial communication links is a huge element by itself."

In 2005 budget testimony before the House and Senate Armed Services Committees, Kadish said sensors now being developed at the MDA's Sensor Segment that could use such a platform include a small, high-power laser radar, high-power gallium arsenide amplifiers, transportable antenna arrays, coherent distributed aperture technologics, and improved focal-plane arrays.

"The first payloads will be off-the-shelf Army radios and IR/EO sensors for missile defense," Payton notes. "We have a suite of about a dozen potential payloads that will want to fly on the airship during its two-year test flight program. The first three flights that summer and fall will just be take off, landing and control. The next will go from Akron to White Sands, N.M., stay on station 30 days, and then return to Akron. That will end the initial flight test. Then we enter a two-year military utility assessment with several flights and different types of sensors."

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The current design has all sensors on a centerline gondola under the airship, although other designs could put radar or communications payloads inside the bag or even hanging below on a cable. Ron Browning, MS2 surveillance systems business development director, also predicts that a future airship could have sensors all over the hull.

"We chose the gondola approach because we didn't want to stress the design team with a complicated payload-integration task. We wanted to keep that as easy as possible," Payton says. But other configurations are possible as the program evolves. "One idea is to use it as a laser relay, hanging a pair of mirrors a few hundred feet below the airship, then taking an airborne-laser output and, instead of directly attacking a ballistic missile in flight, shooting the beam up to the airship, then relaying it to the missile target. We're a long way from doing that, but it is an example."

With its large payload capacity and sensor-placement options, the HAA could handle several functions for a combination of agencies, depending on where it is stationed and the power and placement requirements of its primary mission.

"There is a lot of potential with that much of a view," Browning agrees. "The HAA is relocatable, reconfigurable, and recastable. You can command it to go where you want it to go geographically, albeit at relatively slow speeds compared to conventional aircraft. It is possible they will be prepositioned, perhaps one near Hawaii or one somewhere in Southeast or Southwest Asia, so it has a much shorter distance to go than if it came from the continental U.S. You can bring it down to repair or change out the payload, then send it back up and retask as needed."

Retired Air Force Lt. Gen. James Abrahamson, former director of MDA's predecessor, the Strategic Defense Initiative Organization, sees airships as ideal platforms for coastal and border surveillance. On behalf of StratCom International in Keedysville, Md., which he founded in 1998 and is on the Lockheed Martin HAA team, Abrahamson has raised the surveillance possibility with India, along with using such platforms to expand their communications infrastructure.

The North American Aerospace Defense Command (NORAD) in Colorado Springs, Colo., has a similar concept, estimating fewer than a dozen HAAs could cover all land and water approaches to the continental United States. The Coast Guard and U.S. Border Patrol are looking at it to aid their battle against illegal immigration and drug smuggling. DHS also believes it may have applications in the overall homeland-security effort, while the Pentagon extends that to the wider war on terrorism. UV